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(54) Title: COMPOSITIONS CONTAINING DIOL AND/OR DIOL ALKOXYLATE

(57) Abstract

Disclosed are stable monophasic liquid compositions comprising water, one or more cationic, anionic, amphoteric and/or nonionic agents, exhibiting partial solubility in water or in concentrated formulations, and one or more coupling agents which are C_4-C_{12} alkane substituted with two hydroxyl groups or alkoxylates thereof with up to 40 moles of one or more of ethylene oxide, propylene oxide and/or butylene oxide.

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COMPOSITIONS CONTAINING DIOL AND/OR DIOL ALKOXYLATE

BACKGROUND OF THE INVENTION

The present invention relates to aqueous compositions containing solubilized or dispersed therein one or more cationic, anionic, amphoteric or nonionic surfactants which exhibit low solubility (or no solubility at all) in water, especially in the presence of electrolytes and/or pH agents. For purposes of this application, a substance is considered to be "solubilized" in water if the material is dissolved in the water or if it is uniformly dispersed or distributed therein, or emulsified therein, so as to exhibit the physical appearance and physical properties of a single-phase system (whether as an emulsion, an organic-based formula, or a water-based formula).

As is well known, surfactants can be used to perform a wide variety of useful purposes, ranging from cleaning and surface protection through deposition of coatings, fabric softening, foam stabilization, oil recovery, ore flotation, asphalt emulsification, achieving or enhancing rewetting effectiveness and penetrating power, and a large variety of other capabilities set forth hereinbelow. However, in many cases the ability to take advantage of such surfactants' useful properties is limited by the low solubility and/or dispersibility of many surfactants and surfactant blends in water.

There is also need in the marketplace for products with higher levels of concentration of

surfactants or active ingredients, thus minimizing the amounts of water in the products. As the amount of water in the formulations is reduced, and as formulations add more (and more complex) ingredients, the fluidity and stability become more difficult to maintain. Often the surfactants become insoluble gels when diluted in water, or become hazy or even split into different phases. Surfactants often become insoluble in formulations where the concentration of inorganic salts is very high. In other surfactant formulations, maintaining the fluidity and dispersibility of the surfactant in water are serious problems which limit their use and application. Many surfactants are difficult to even disperse in water, requiring both hot water and long periods of mixing for dissolution into solution.

The present invention relates in particular to liquid formulations containing one or more cationic compounds, such as: liquid fabric softeners of the type conventionally employed in the rinse cycle of automatic clothes washing machines; liquid textile softeners used for fabric finishing; compositions used in the paper industry for debonding and softening of paper fibers; hair and skin conditioners; compositions applied to clay-based products such as drilling muds to make them hydrophobic; and many other uses.

The present invention relates more particularly to novel compositions for liquid cationic formulations, wherein the ingredients of the composition contribute significantly to the ease of

formulation, stability, dispersibility, fluidity and the performance properties of the compositions.

Cationics have achieved widespread usage because of their ability to impart to fabric, (i.e. articles of clothing, textiles, and so forth), paper, hair, and many other substrates, properties including softness to the touch, ease of handling, increased lubricity, and a reduced tendency to carry or pick up static electricity. One form in which cationics are provided is as a liquid, for instance as an emulsion or as a solution/suspension of the desired components. An appropriate controlled amount of the liquid cationic formulation is employed (poured into the washing machine or textile bath in which the fabric is being washed or rinsed; or applied to the hair; or added to the head tank of the paper making machine, or otherwise depending on the application).

Typically, in the case of liquid fabric softeners it is provided during the rinse cycle of the washing machine, either poured in by hand or metered in by an appropriate automatic metering device with which the washing machine is equipped. In the same vein, cationics (typically dialkyl quaternaries) are used in textile mills to add lubricity and finishing to the fabric prior to shipping the textile to market. The mill applies the cationic formulation in dilute emulsions and rapidly dries the excess water from the fabric. The fibers are thus lubricated and given a surface finish. Hair conditioners are applied as dilute cationic emulsions to the hair following its wash. Adding these conditioners (typically dialkyl

quaternaries) reduces the tendency for tangling, improves the manageability, and imparts a soft feel to the hair strands. In the papermaking process, cationics called debonders are generally quaternary salt emulsions in water. These are added to the head tank wherein the dilute fibers are conditioned with the debonders just prior to being fed onto the papermaking screen. These debonders give improved softness feeling to the paper fibers. In all cases the cationics are added to hot water to make an emulsion, and then added to the substrate in water or added to the substrate in water or added as a high solids concentrate to the substrate, to impart softness, lubricity, antistatic properties, ease of handling of the substrate and to improve surface appearance.

It is believed that the user finds it to be desirable that the liquid cationic formulation is in the form of a moderately viscous fluid, rather more viscous than water yet still capable of flowing under its own weight. Thus, for instance, having a formulation that at solids concentrations of less than 5% exhibit viscosities greater than 100 cps which would be effective in softening and disperse readily in cold water, such as the present invention, would be desirable in the marketplace. In other cases, the industrial user may want less viscous, fluid emulsions or concentrates that disperse easily, with fine particle sizes.

In the case of fabric softeners, formulations which would be low melting (compared to

many softener raw materials which must be heated to 90-120°F.) and are easily dispersed in room temperature water would save time and money in both equipment and production costs.

High solids formulations (or "ultras") which have solids contents greater than 20% have seen large commercial success over the last five years. The drive to increase solids contents, and to reduce handling and transportation costs is becoming ever more important. The desire ultimately to form a clear, highly active, high performance product when the product is dispersed in water is becoming an important objective. The standard emulsion type fabric softener ultras in the market suffer from thickening problems following production, causing reduced dispersibility in the rinse cycle.

There is a need for cationic formulations, including fabric softeners, which are nonflammable yet easy to handle and disperse in room temperature water. Most quaternary formulations contain isopropanol or ethanol as solvents in order to aid in production and handling. However, volatile solvents such as these are becoming an important environmental issue in states including California and Florida. Thus, a different technique for achieving fluidity and good dispersiblity, while avoiding the use of volatile solvents, is needed. Also, as interest grows in dilutable concentrated product which can be diluted by the customer (e.g. by 3-10 times) to make a regular (2-10%) concentration of the product as used, the need for making such products that are easily dispersible

without resort to volatile or flammable solvents is very important.

Thus, there is still a need in this field for liquid cationic formulations which can be prepared more readily without encountering difficulties such as those described above, and are more concentrated and disperse easily in cold water. There is also a need in this field for cationic formulations which can be manufactured as concentrates, wherein formulators can produce consumer and industrial products easily, quickly and effectively with minimal equipment and heating requirements. There is also a need for products (especially for use in the textile and paper areas) which are not flammable but which avoid the handling and viscosity problems posed by the conventional less flammable substitutes such as propylene glycol, diethylene glycol and the like.

Hydrotropes or, more generally, coupling agents are added to surfactant formulations to increase the amount of the relatively water-insoluble surfactants that can be solubilized into the system. In most cases, they do not act as surfactants to lower surface tension but they often allow surfactants in the presence of salts or electrolytes to be added and subsequently dispersed into water at higher concentrations or at lower viscosities of the formulation than is otherwise achieved using only surfactant and water. These coupling agents assist surfactants by increasing the surfactant's solubility in water and its stability in the formulation,

especially in the presence of salts, electrolytes and/or pH agents.

Hydrotropes or coupling agents generally contain short chained (C_2-C_6) hydrophobes with more bulky hydrophilic group(s) such as hydroxyl and/or sulfonates making them completely water-soluble. They are normally added to stabilize formulations of surfactants, salts and water and to hold them in single-phase systems.

Materials that have been proposed for use as coupling agents include hexylene glycol, propylene glycol, dipropylene glycol, diethylene glycol, any of various lower alkoxy-capped glycols or polyglycols, particularly where the glycol is ethylene glycol or propylene glycol, such as ethylene glycol monobutyl ether, alcohols such as isopropanol and ethanol, and certain aryl sulfonates such as sodium naphthalene sulfonate and sodium xylene sulfonate, as well as some phosphate esters. However, despite the abilities of these water-soluble products as coupling agents that have been suggested for these materials, there remains a need and an interest in identifying coupling agents and systems containing such coupling agents which not only exhibit superior stability and superior ability to solubilize relatively water-insoluble agents but also improve formulation fluidity, dispersiblity and product performance.

In addition, coupling agents that have improved permissible-exposure limits, higher flash points (over, for instance, isopropanol and ethanol), and lower odor (compared to, for example, butyl

cellosolve or isopropanol) would have substantial importance to formulations and consumers. Other coupling agents such as sodium xylene sulfonate containing aromatic rings have come under environmental scrutiny in recent times.

The prior art concerning various cationic compositions is extensive, yet has not taught or suggested the considerable and unexpected benefits that are provided by the formulations which correspond to the present invention. For instance, U.S. Patent No. 5,399,272 discloses a clear or translucent liquid fabric softening composition containing any of certain ester-quaternary cationic compounds. The disclosure also requires any of certain alcohols, glycols, esters or ethers as solvent.

However, the disclosure of U.S. Patent No. 5,399,272 also requires a second quaternary compound and/or an amine oxide to serve as a dispersibility aid. The requirement for this dispersibility aid serves as a teaching that the disclosed solvent system does not adequately provide needed dispersiblity on its own, that is, in the absence of a dispersibility aid. This teaching thus serves to confirm the present state of the art, namely, that there remains a need for formulations which serve to solubilize and disperse cationic active agents without needing to resort to the addition of dispersibliity aids. After all, extra dispersibliity aids will add to the cost of materials, and having to add another cationic to the formulation could in some cases interfere with obtaining desired fluidity, maintaining a monophasic

state, or obtaining the desired performance properties.

The composition disclosed in U.S. Patent No. 4,692,277 represents an attempt to incorporate certain diol solvents into hard surface cleaning formulations. The disclosure, however, is limited to liquid hard surface detergents/cleaners which contain at most 10% of a surfactant, and which must contain 1% to 30% of a detergency builder salt. The necessity of these components in the indicated amounts attests to the specific, limited nature of the teachings of this patent. More fundamentally, the disclosure of this patent was concerned solely with the solvent power of C_6-C_{16} diols as to their effect on soap scum removal when combined with both surfactants and salt builders, and completely fails to suggest or appreciate that it is possible, through selection of components according to the present invention, to employ certain diols and/or alkoxylates thereof so as to attain the solubilization of much higher amounts of less soluble surfactant(s) while retaining the desired monophasic state of the resulting composition. Thus, in turn, this patent thereby also fails to suggest any of the many end-use (especially monophasic) formulations that can be prepared embodying the compositions afforded by the present invention in combination with other hydrophobic surfactants, be they active ingredients or otherwise.

The present invention satisfies the needs identified above, and provides as well additional

advantages that will become apparent in the following description.

BRIEF SUMMARY OF THE INVENTION

One aspect of the present invention comprises homogeneous aqueous liquid compositions comprising (a) one or a combination of compounds of the formula (1)

$$HO-(X-O)_x-R-(O-Y)_y-OH \quad (1)$$

wherein each X is ethylene, straight or branched propylene or straight or branched butylene; x is 0-40; each Y is ethylene, straight or branched propylene, or straight or branched butylene; y is 0-40; the sum of (x+y) is 0-40; and R is straight, cyclic or branched alkylene containing 4-12 carbon atoms, provided that if x and y are both zero then R contains 7 to 12 carbon atoms; and (b) one or more cationic, anionic, amphoteric or nonionic agents. In many embodiments, the component (b) comprises one or more cationic agents, i.e., quaternary ammonium compounds and/or amine salts as described herein.

Another aspect of the present invention comprises highly concentrated homogeneous compositions having the aforementioned composition, which concentrates are easily dispersible in water.

Another aspect of the present invention comprises the method of manufacturing a homogeneous liquid composition, by combining one or more compounds of the aforementioned formula (1), water, and one or

more cationic, anionic, amphoteric, or nonionic agents under conditions to form a homogeneous liquid product therefrom.

Another aspect of the invention is the method of increasing the amount of cationic, anionic, amphoteric, or nonionic surfactant or a mixture of two or more thereof that can be solubilized in water, especially as to surfactants which exhibit low solubility in water, the method consisting of solubilizing together water, one or more of said surfactants, and one or more coupling agents selected from the group consisting of straight, branched and cyclic, saturated, alkanes containing 7 to 12 carbon atoms and substituted with two hydroxyl groups, and alkoxylates thereof with up to 20 moles of ethylene oxide, propylene oxide, butylene oxide, or mixtures thereof, in an amount effective to increase the amount of said surfactant that can be solubilized in the resulting aqueous composition.

DETAILED DESCRIPTION OF THE INVENTION

The compounds of the aforementioned formula (1), sometimes referred to herein as diols and diol alkoxylates, contribute essentially to many of the advantageous properties of the compositions of the present invention. In formula (1), the molecule can comprise one or two terminal poly(alkoxy) chains. While, as defined above, each alkoxy unit can be ethoxy, propoxy, or butoxy, a mixture of types of alkoxy groups, or block copolymers composed of a chain of one type of repeating alkoxy unit attached to a

chain of a different type of repeating alkoxy unit, are especially contemplated.

The alkylene residue R in formula (1) represents a saturated, straight-chain, branched-chain, or cyclic moiety containing 4 to 12 carbon atoms. It is preferred that R is branched; the term "branched" is intended to encompass structures having one side alkyl chain, more than one side alkyl chain, or one or more side alkyl chains one or more of which is itself branched. Branched structures include cyclic structures substituted with one or more alkyl groups which can be straight or branched. Examples of suitable R groups include $-CH_2CH_2CH_2-$, $-C(CH_3)CH_2-$, $-CH_2CH(CH_3)CH_2-$, $-CH_2C(CH_3)_2CH_2-$, $-CH_2CH(CH_2CH_2CH_2CH_3)-$, $-(CH_2)_6-$, $-CH(CH_2)_2CH(CH_2)_2-$, $-CH_2C(CH_3)_2CH(CH(CH_3)_2)-$, and $-CH_2CH(CH_2CH_3)CH_2CH_2CH_2CH_2-$.

In the alkoxylated diols, the number of repeating units in each poly(alkoxy) chain can be up to 40 but it is preferred that each chain contains 1 to 20 or even 1 to 10 repeating alkoxy units or more preferably 1 to 5 alkoxy units. The preferred alkoxy chains are poly(ethoxy), or are composed of 1 to 2 ethoxy units capped with a chain of 1 to 5 propoxy units.

Compounds of the formula (1) defined above are in many instances commercially available. Compounds of formula (1) can be prepared in straightforward manner familiar to those of ordinary skill in this art by obtaining or preparing the corresponding precursor diol of the formula HO-R-OH,

and then alkoxylating the precursor diol with a stoichiometrically appropriate number of moles of the desired corresponding alkylene oxide, such as ethylene oxide, propylene oxide, and/or butylene oxide. In those cases where it is desired to alkoxylate only one of the hydroxyl groups on the precursor diol, in some embodiments the alkoxylation will preferentially occur at only one of the hydroxyl groups, particularly where one of them is a primary hydroxyl and the other is a secondary hydroxyl. However, in those cases where both hydroxyl groups on the precursor diol might tend to alkoxylate but alkoxylation at only one of the hydroxyl groups is desired, the hydroxyl group at which alkoxylation is desired not to occur can be protected by preliminarily reacting it with a suitable protecting group such as a lower alkyl moiety or an esterifying substituent. Thereafter, following the alkoxylation, the protecting group is removed in a known manner.

Preferred examples of compounds of the foregoing formula (1) include any one, or mixtures, of 2,2,4-trimethyl-1,3-pentane diol (referred to herein as "TMPD") and/or 2-ethylhexane-1, 3-diol, and/or the reaction product of TMPD and/or 2-ethylhexane-1, 3-diol with 1 to 20 moles of ethylene oxide, and preferably with 2 to 5 moles of ethylene oxide, as well as analogs alkoxylated with other C_3 or C_4 alkyl oxides or mixtures of any of C_2, C_3 and/or C_4 alkyl oxides. Since the diol which is alkoxylated includes one primary hydroxyl group and one secondary hydroxyl group, the alkoxylation proceeds predominantly at the

primary hydroxyl group. Segments can be all of one type of alkoxy group, can be composed of blocks wherein each block is composed of only one type of alkoxy group, or can be composed of varying combinations of 2 or all 3 types of alkoxy group. It is believed that such alkoxylation produces a derivative wherein a linear polyalkoxylate chain is pendant predominately from the 1-terminal oxygen atom. This alkoxylation makes these higher molecular weight diols fluid and easier to formulate.

The present discovery has particular utility with surfactants that are either insoluble in water, or exhibit partial solubility in water such as up to 10 grams per 100 milliliters of water (in the absence of surfactants, coupling agents, or other solubility-enhancing additives). However, the present discovery also is useful with surfactants which exhibit even complete solubilities in water but which are difficult to disperse or to produce fluid, low viscosity formulations in water, and/or highly concentrated surfactant blends with or without electrolytes, builders and/or pH agents or other active agents.

Satisfactory surfactants useful herein can readily be identified in well-known sources such as McCutcheon's Detergents & Emulsifiers, and the CTFA Cosmetic Ingredient Dictionary.

Anionic surfactants include in particular organosulfonates and organosulfates, which can be characterized by the formula X^1-A^1 wherein A^1 denotes sulfonate or sulfate, attached anywhere to X^1 and most often at one end of X^1, and X^1 denotes:

alkyl containing 6 to 40 carbon atoms, optionally substituted with 1 to 10 hydroxyl groups, and optionally substituted with aryl (particularly phenyl) which is optionally substituted with one or more alkyl or alkylene groups containing 1 to 20 carbon atoms and up to 3 carbon-carbon double bonds;

alkylene containing 6 to 40 carbon atoms and 1 to 6 carbon-carbon bonds, and optionally substituted with 1 to 10 hydroxyl groups, and optionally substituted with aryl (particularly phenyl) which is optionally substituted with one or more alkyl or alkylene groups containing 1 to 20 carbon atoms and up to 3 carbon-carbon double bonds;

amides and esters containing a total of 6 to 50 carbon atoms and optionally containing 1 to 6 carbon-carbon double bonds;

polyalkoxy segments, particularly homopolymers, random copolymers, and block copolymers, of ethylene oxide and/or propylene oxide, containing 2 to 200 alkoxy units, per se or terminated with alkyl or alkylene containing 2 to 40 carbon atoms, which may optionally be substituted with 1-10 hydroxyl groups, or terminated with aryl (particularly phenyl) which may optionally be substituted with one or more alkyl or alkylene groups containing 1 to 20 carbon atoms and up to 3 carbon-carbon double bonds.

The anionic component is counterbalanced by a cation X which is preferably an alkali metal (e.g. sodium, potassium or lithium).

Cationic surfactants include quaternary ammonium compounds, particularly those of the formula

$(Q^1)(Q^2)N^+(Q^3)(Q^4)-(An)^-$

wherein $(An)^-$ is an anion such as halide (especially bromide or chloride), methylsulfate, or ethylsulfate, and Q^1, Q^2, Q^3 and Q^4 are selected such that 2 or 3 thereof are C_{1-4} alkyl (optionally one of which is benzyl) and 1 or 2 thereof are alkyl or alkylene containing 8 to 24 carbon atoms and optionally up to 3 carbon-carbon double bonds, or poly(alkoxy) wherein each alkoxy unit is ethoxy or propoxy, containing up to 200 alkoxy units. Also included are polymeric quaternary ammonium salts including those known generically as polyquatermium -1, -2, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, and -14.

Amphoteric surfactants particularly include those of the formula (IVa) and (IVb)

$R^4-(OC_3H_6)_{0-1}(C(O)NH(CH_2)_{1-3})_{0-1}-N(Z^1)(Z^2)_{0-1}-ZCOOH$ (IVa)

$R^4-(OC_3H_6)_{0-1}(C(O)NH(CH_2)_{1-3})_{0-1}-N(Z^1)(Z^2)_{0-1}-ZSO_3H$ (IVb)

salts thereof with an alkali metal X or ammonium cation and mixtures of any said compounds and salts, wherein X is as defined above, R^4 is straight or branched alkyl or alkylene, or cyclic or heterocyclic aromatic which is optionally substituted with alkyl, and contains 4 to 40 carbon atoms and 0-3 carbon-carbon double bonds, Z^1 and Z^2 are independently of each other H, C_fH_{2f-1} or $C_fH_{2f}OH$ wherein f is 1 to 6 and preferably 1, Z or 3 or, in formula (IVa), one of Z^1

and Z^2 can be -ZCOOH or -ZCOOX, and Z is $(CH_2)_t$, $CH_2CH_2OCH_2$, or $CH_2CHOHCH_2$;

Formulas (IVa) and (IVb) embrace betaines, sulfobetaines (sultaines), glycinates and propionates, which are commercially available and/or can readily be synthesized. Examples of preferred amphoteric surfactants include fatty betaines such as lauryl dimethyl betaine (e.g. REWOTERIC® AM-DML-35)(this and all other REWOTERIC®-branded compounds are marketed by Witco Corp.) and N-lauryl-beta-iminopropionic acid, mono-sodium salt (e.g. REWOTERIC® AM-LP); glycinates such as N-cocoylamidoethyl-N-(2-hydroxyethyl)-N-carboxymethyl glycine, sodium salt (e.g. REWOTERIC® AM-2C-W) and as lauryl hydroxy sultaine (e.g. REWOTERIC®-AM-B-15); propionates such as sodium cocoamphopropionate (e.g. REWOTERIC® AM-KSF-40); and sulfobetaines such as lauryl hydroxy sultaine (e.g. REWOTERIC AM-CAS).

Preferred R^4 groups include alkyl and alkylene radicals derived from fatty acids. Other preferred R^4 groups include benzyl and alkyl-substituted benzyl.

Nonionic surfactants include any nonionic compounds having surface active capability. Examples include

-esters, amides, and alkanolamides, containing a total of 6 to 40 carbon atoms, optionally zero to 3 carbon-carbon double bonds and optionally substituted with 1 to 20 hydroxyl groups (as e.g. polyglycol) esters;

-homopolymers, random copolymers and block copolymers of ethylene oxide and/or propylene oxide and/or ethylene glycol and/or propylene glycol, containing 2 to 200 repeating units;

-any of the foregoing homopolymers, random copolymers and/or block copolymers, but especially poly(ethylene oxide), substituted with alkyl or alkylene containing 1 to 40 carbon atoms and optionally up to 6 carbon-carbon double bonds, and optionally 1 to 20 hydroxyl groups, or with an ester, amide, amine, alkanolamide or with an aryl group (especially phenyl) or an aryl-alkyl group, itself optionally substituted with alkyl or alkylene containing up to 40 carbon atoms and optionally containing 6 carbon-carbon double bonds; and

-sorbitol derivatives, including those known guerically as polysorbate -20, -32, -40, -60, -61, -65, -80, -81, and -85. The cationic component useful in the present invention is one compound, or a combination of more than one compound, which compound or combination exhibits or imparts to the final product the properties desired for the intended use. Those properties include imparting to fabric, textiles, paper fibers, hair and other substrates a feeling of increased softness to the touch and a reduced tendency to carry or pick up static electricity.

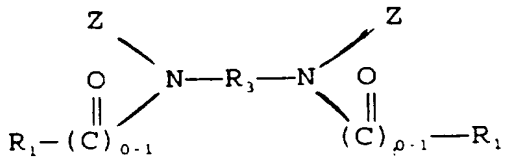
Compounds one or more of which make up the cationic component, are typically nitrogenous compounds, e.g. secondary or tertiary amines,

quaternary ammonium compounds, amine salts and diamine and triamine counterparts thereof.

As indicated, the present invention and its attendant advantages are realized with any cationic agent and particularly those which are mono- or di-(long chain alkyl) derivatives. Without intending to limit the scope of this invention, the following are provided as examples of cationic agents that can be employed in the present invention. That is, the present invention is intended to extend to compositions containing any other cationic compound that may not be mentioned herein.

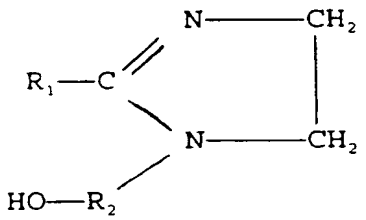
Cationic agents usable in the present invention include, but are not limited to, nitrogenous compounds selected from the group consisting of quaternized or acid salt derivatives of:

(i) alkylenediamines including compounds of the formula:

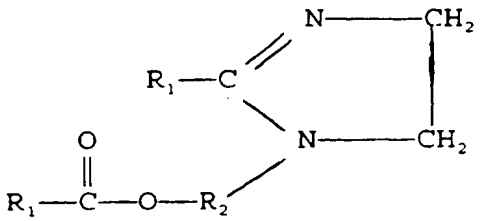


wherein each R_1 is an acyclic alkyl or alkylene C_{12}-C_{21} hydrocarbon group, each Z is $-(R_2O)_{0-4}H$, or $-R_2H$, and R_2 and R_3 are divalent C_1-C_6 alkylene groups;

(ii) substituted imidazoline compounds having the formula:

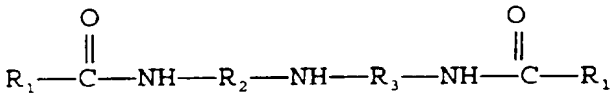


(iii) substituted imidazoline compounds having the formula:



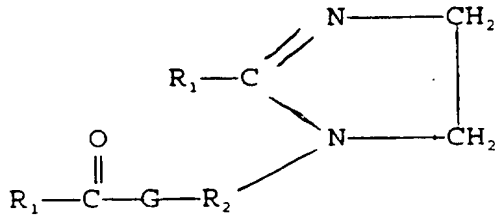
wherein R_1 and R_2 are defined as above;

(iv) reaction products of higher fatty acids with alkylenetriamines in, e.g., a molecular ratio of about 2:1, said reaction products containing compounds of the formula:



wherein R_1, R_2 and R_3 are defined as above;

(v) substituted imidazoline compounds having the formula:



wherein G is -O- or -NH- and R_1 and R_2 are defined as above; and mixtures thereof.

Preferred examples of compounds of formula (i) are those derived from hydrogenated tallow fatty acids and the hydroxyalkylalkylenediamine N-2-

hydroxyethylethylenediamine, such that R_1 is an aliphatic C_{15}-C_{21} hydrocarbon group, and R_2 and R_3 are divalent ethylene groups.

A preferred example of compounds of formula (ii) is stearic hydroxyethyl imidazoline wherein R_1 is an aliphatic C_{21} hydrocarbon group and R_2 is a divalent ethylene group.

A preferred example of compounds of formula (iv) is N,N"-ditallowalkanoyldiethylenetriamine where R_1 is an aliphatic C_{15}-C_{21} hydrocarbon group and R_2 and R_3 are divalent ethylene groups.

A preferred example of compounds of formula (v) is 1-tallowamidoethyl-2-tallowimidazoline wherein R_1 is an aliphatic C_{15}-C_{21} hydrocarbon group and R_2 is a divalent ethylene group.

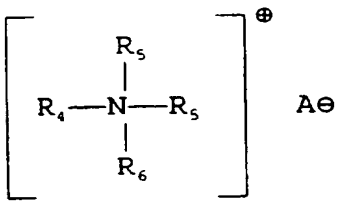
Both N,N"-ditallowalkanoyldiethylenetriamine and 1-tallowethylamido-2-tallowimidazoline are reaction products of tallow fatty acids and diethylenetriamine, and are precursors of the cationic fabric softening agent methyl-1-tallowamidoethyl-2-tallowimidazolinium methylsulfate (see "Cationic Surface Active Agents as Fabric Softeners," R.R. Egan, Journal of the American Oil & Chemicals Society, January 1978, pages 118-121). N,N"-ditallowalkanoyldiethylenetriamine and 1-tallowamidoethyl-2-tallowimidazoline can be obtained from Witco Corporation. Methyl-1-tallowamidoethyl-2-tallowimidazolinium methylsulfate is sold by Witco Corporation under the trade name Varisoft® 475.

Other useful softening agents include cationic nitrogenous quaternary ammonium compounds and

salts. In the cationic nitrogenous salts herein, the anion $A^{\ominus}$ provides electrical neutrality. Most often, the anion used to provide electrical neutrality in these salts is a halide, such as chloride, bromide, or iodide. However, other anions can be used, such as methylsulfate, ethylsulfate, acetate, formate, sulfate, carbonate, and the like. Chloride and methylsulfate are preferred herein as the anion A^-.

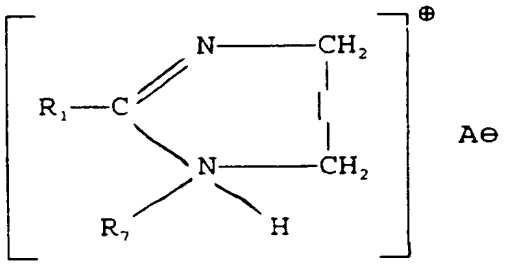
One type of cationic compounds are those containing one long chain acyclic aliphatic C_8-C_{22} hydrocarbon group, selected from the group consisting of:

(vi) acyclic quaternary ammonium salts having the formula:



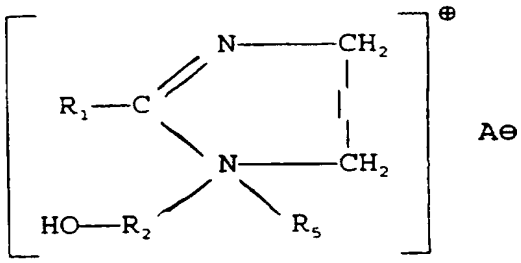
wherein R_4 is an acyclic aliphatic C_8-C_{22} hydrocarbon group, alkyl, benzyl or (C_4-C_{18} alkyl)-$(OCH_2CH_2)_{2-3}$-, R_5 and R_6 are C_1-C_4-saturated alkyl or hydroxyalkyl groups and $A^{\ominus}$ is an anion;

(vii) substituted imidazolinium salts having the formula:



wherein R_1 is an acyclic alkyl or alkylene C_{12}-C_{21} hydrocarbon group, R_7 is hydrogen or a C_1-C_4 saturated alkyl or hydroxyalkyl group, and $A^\ominus$ is an anion;

(viii) substituted imidazolinium salts having the formula:



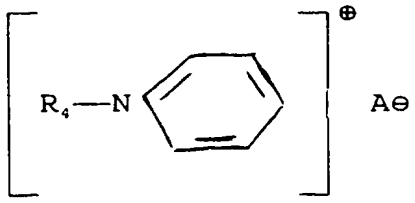
wherein R_1, R_2, R_5 and $A^\ominus$ are as defined above;

(ix) diquaternaries of the formula

$(R^1N(Z_2)-(CH_2)_{2-6}-N(Z_3))^{+2}\bullet 2A^-$

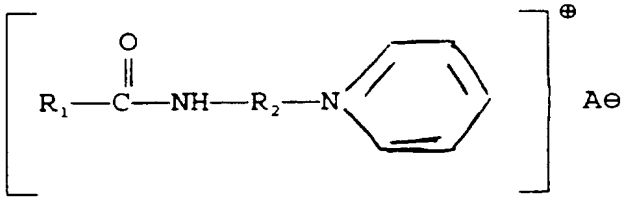
wherein R_1 and each Z are independently as defined above;

(x) alkylpyridinium salts having the formula:



wherein R_4 is an acyclic aliphatic C_8-C_{22} hydrocarbon group and A^e is an anion; and

(xi) alkanamide alkylene pyridinium salts having the formula:



wherein R_1 is an acyclic aliphatic C_{12}-C_{21} hydrocarbon group, R_2 is a divalent C_1-C_6 alkylene group, and A^e is an anion; and mixtures thereof.

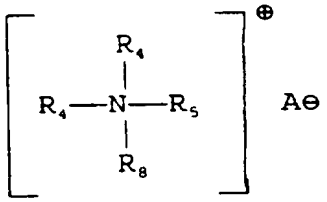
Examples of compound (vi) are the monoalkyltrimethylammonium salts such as monotallowtrimethylammonium chloride, mono(hydrogenated tallow)-trimethylammonium chloride, palmityltrimethylammonium chloride and soyatrimethylammonium chloride, sold by Witco Corporation under the trade names Adogen 471, Adogen 441, Adogen 444, and Adogen 415, respectively. In these compounds, R_4 is an acyclic aliphatic C_{16}-C_{18} hydrocarbon group, and R_5 and R_6 are methyl groups.

Mono(hydrogenated tallow)trimethylammonium chloride and monotallowtrimethylammonium chloride are preferred. Other examples of compound (vi) are behenyltrimethylammonium chloride wherein R_4 is a C_{22} hydrocarbon group and sold under the trade name Kemamine® Q2803-C by Humko Chemical Division of Witco Corporation; soyadimethylethylammonium ethylsulfate wherein R_4 is a C_{16}-C_{18} hydrocarbon group, R_5 is a methyl group, R_6 is an ethyl group, and A^- is an ethylsulfate anion; and methyl bis(2-hydroxyethyl)octadecylammonium chloride wherein R_4 is a C_{18} hydrocarbon group, R_5 is a 2-hydroxyethyl group and R_6 is a methyl group.

An example of compound (viii) is 1-ethyl-1-(2-hydroxyethyl)-2-isoheptadecylimidazolinium ethylsulfate wherein R_1 is a C_{17} hydrocarbon group, R_2 is an ethylene group, R_5 is an ethyl group, and A^- is an ethylsulfate anion.

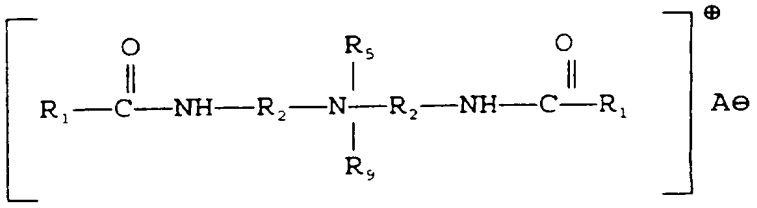
Other fabric softening agents useful in the present invention include cationic nitrogenous salts having two or more long chain acyclic aliphatic C_8-C_{22} hydrocarbon groups or one said group and an arylalkyl group. Examples include:

(xii) acyclic quaternary ammonium salts having the formula:



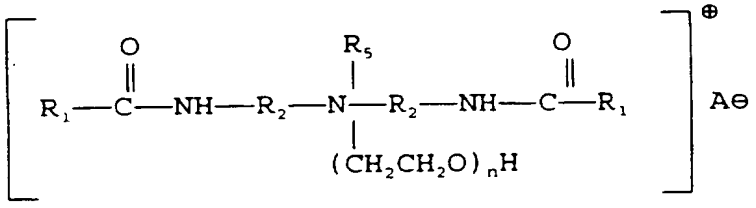
wherein each R_4 is an acyclic aliphatic C_8-C_{22} hydrocarbon group, R_5 is a C_1-C_4 saturated alkyl or hydroxyalkyl group, R_8 is selected from the group consisting of R_4 and R_5 groups, and $A^\ominus$ is an anion defined as above;

(xiii) diamido quaternary ammonium salts having the formula:



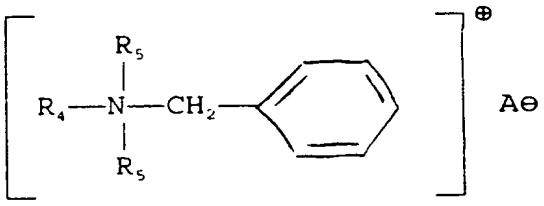
wherein each R_1 is an acyclic alkyl or alkylene C_{12}-C_{21} hydrocarbon group, each R_2 is a divalent alkylene group having 1 to 3 carbon atoms, R_5 and R_9 are C_1-C_4 saturated alkyl or hydroxyalkyl groups, and $A^\ominus$ is an anion;

(xiv) alkoxylated diamido quaternary ammonium salts having the formula:



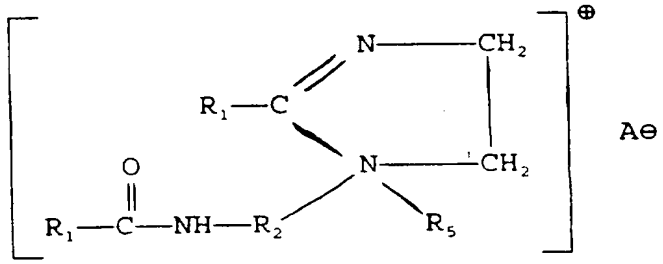
wherein n is equal to 1 to about 5, and R_1, R_2, R_5 and $A^\ominus$ are as defined above;

(xv) quaternary ammonium compounds having the formula:



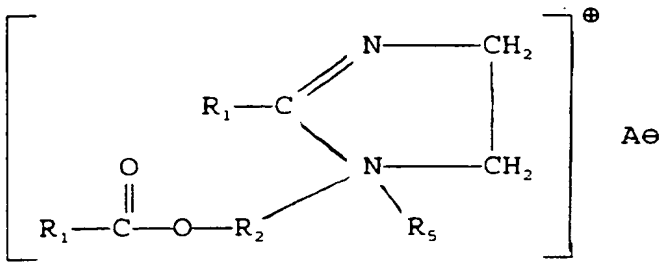
wherein each R_4 is an acyclic aliphatic C_8-C_{22} hydrocarbon carbon group, each R_5 is a C_1-C_4 saturated alkyl or hydroxyalkyl group, and $A^\ominus$ is an anion;

(xvi) amide-substituted imidazolinium salts having the formula:



wherein each R_1 is an acyclic aliphatic C_{12}-C_{21} hydrocarbon group, R_2 is a divalent alkylene group having 1 to 3 carbon atoms, and R_5 and $A^\ominus$ are as defined above or R^5 is -H; and

(xvii) ester-substituted imidazolinium salts having the formula:



wherein R_1, R_2, R_5 and $A^{\ominus}$ are as defined above; and mixtures thereof.

Examples of compound (xii) are the well-known dialkyldimethylammonium salts such as ditallowdimethylammonium chloride, ditallowdimethylammonium methylsulfate, di(hydrogenated tallow)dimethylammonium chloride, distearyldimethylammonium chloride, dibehenyldimethylammonium chloride. Di(hydrogenated tallow)dimethylammonium chloride and ditallowdimethylammonium chloride are preferred. Examples of commercially available dialkyldimethylammonium salts usable in the present invention are di(hydrogenated tallow)dimethylammonium chloride (trade name Adogen 442), ditallowdimethylammonium chloride (trade name Adogen 470), distearyldimethylammonium chloride (trade name Arosurf TA-100), all available from Witco Corporation. Dibehenyldimethylammonium chloride wherein R_4 is an acyclic aliphatic C_{22} hydrocarbon group is sold under

the trade name Kemamine Q-2802C by Humko Chemical Division of Witco Corporation.

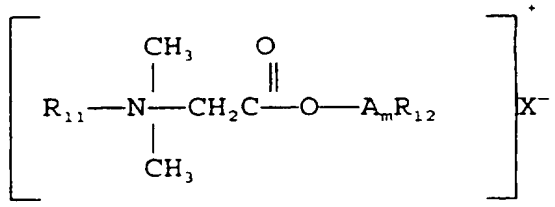
Examples of compound (xiii) are methylbis(tallowamidoethyl) (2-hydroxyethyl)ammonium methylsulfate and methylbis(hydrogenated tallowamidoethyl)(2-hydroxyethyl)ammonium methylsulfate wherein R_1 is an acyclic aliphatic C_{15}-C_{17} hydrocarbon group, R_2 is an ethylene group, R_5 is a methyl group, R_9 is a hydroxyalkyl group and A^- is a methylsulfate anion; these materials are available from Witco Corporation under the trade names Varisoft 222 and Varisoft 110, respectively.

An example of compound (xv) is dimethylstearylbenzylammonium chloride wherein R_4 is an acyclic aliphatic C_{18} hydrocarbon group, R_5 is a methyl group and A^- is a chloride anion, which is sold under the trade name Varisoft SDC by Witco Corporation.

Examples of compound (xvi) are 1-methyl-1-tallowamidoethyl-2-tallowimidazolinium methylsulfate and 1-methyl-1-(hydrogenated tallowamidoethyl)-2-(hydrogenated tallow)imidazolinium methylsulfate wherein R_1 is an acyclic aliphatic C_{15}-C_{17} hydrocarbon group, R_2 is an ethylene group, R_5 is a methyl group and A^- is a chloride anion; they are sold under the trade names Varisoft 475 and Varisoft 445 respectively, by Witco.

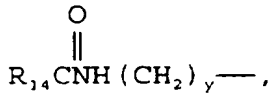
Additional examples of fabric softening compounds useful in the present invention include

(xviii) compounds characterized by the formula:

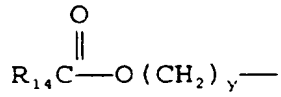


wherein

R_{11} is a radical selected from the group consisting of (a) straight chain aliphatic hydrocarbon radicals each of which contains from 12 through 24 carbon atoms, (b) ether radicals each of which has the structure: $R_{13}O(CH_2O)_y$-, (c) amide radicals each of which has the structure:



and (d) ester radicals each of which has the structure:



R_{12} is a straight chain aliphatic hydrocarbon radical containing from 12 to 32 carbon atoms,

R_{13} is a straight chain aliphatic hydrocarbon radical containing from 8 to 18 carbon atoms,

R_{14} is a straight chain aliphatic hydrocarbon radical containing from 7 to 17 carbon atoms,

A is an alkoxy radical containing one oxygen atom and either two or three carbon atoms,

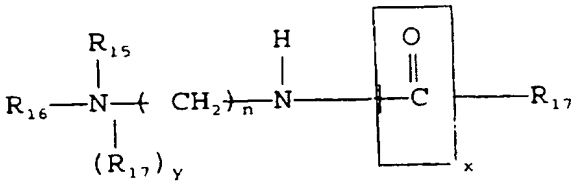
X is an atom selected from the group consisting of bromine and chlorine,

m is an integer of from 1 through 12, and

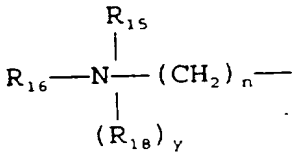
y is an integer which is either 2 or 3.

Yet additional examples of fabric softening compounds useful in the present invention include

(xix) compounds having the formula:

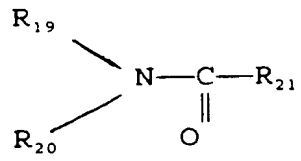


wherein each R_{15} is selected from the group consisting of hydrogen and C_1-C_4 alkyl, each R_{16} is selected from the group consisting of C_1-C_4 alkyl and



each R_{17} is selected from the group consisting of C_8-C_{28} alkyl and alkenyl groups, each R_{18} is selected from the group consisting of hydrogen and C_1-C_4 alkyl, each y is 0 or 1, x is 0 or 1 and each n is from 1 to 6;

(xx) amides represented by the formula:

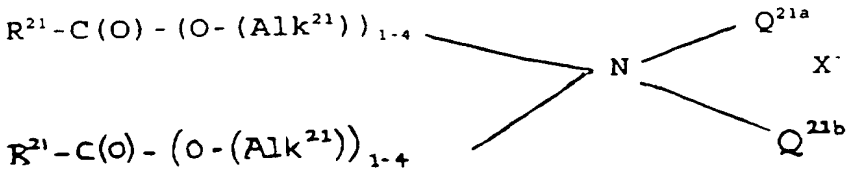


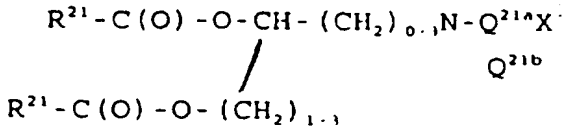
wherein R_{19} and R_{20} are, selected independently, C_{1-22} alk(en)yl aryl, or alkyl aryl groups, R_{21} is hydrogen, or a C_{1-22} alk(en)yl, aryl or alkyl-aryl group, or is O-R_4, wherein R_{22} is a C_{1-22} alk(en)yl, aryl or alkyl-aryl group, and R_{21} and R_{22} possibly containing 1 to 10 ethylene oxide units, or functional groups selected from hydroxy, amine, amide, ester, and ether groups; the aryl groups being possibly derived from hetero-cyclic compounds; at least one of the R_{19} and R_{20} groups contains 10 or more carbon atoms; the sum of carbon atoms in $R_{19}+R_{20}+R_{21}$ is equal to or greater than 14. Preferably, the sum of carbon atoms in $R_{19}+R_{20}$ is equal to or greater than 16.

Such species include N,N-ditallow acetamide, N,N-dicoconut acetamide, N,N-dioctadecyl propanamide, N-dodecyl, N-octadecyl acetamide, N-hexadecyl, N-dodecyl butanamide, N,N-ditallow benzamide, N,N-dicoconut benzamide, and N,N-ditallow 2-phenyl acetamide.

Additional fabric softening compounds useful in the present invention include all ester-quaternaries, including but not limited to:

(xxi) compounds of any of the formulas





wherein

each R^{21} is independently a saturated or unsaturated alkyl or alkylene radical containing 12 to 22 carbon atoms;

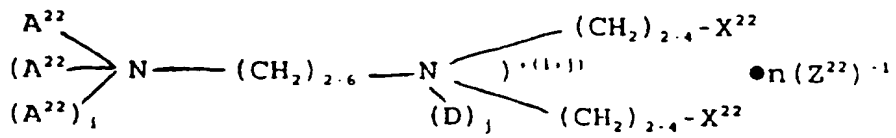
Q^{21a} and Q^{21b} are alkyl containing 1 to 4 carbon atoms or benzyl, $-CH_2CH_2OH$, or $-CH_2CH(OH)CH_3$, or Q^{21a} can be $R^{21}-C(O)-(O-(Alk^{21}))_{1-4}-$;

each Alk^{21} is independently C_2H_4, C_3H_6 or C_4H_8;

R^2 is alkyl containing 1 to 4 carbon atoms or benzyl, $-CH_2CH_2OH$ or $-CH_2CH(OH)CH_3$; and

X^- is an anion;

(xxii) compounds of the formula



wherein each A^{22} is the same or different and each is alkyl containing up to 3 carbon atoms, benzyl, or $H-(Alk^{22}-O)_{1-3}-Alk^{22}-$ wherein each Alk^{22} signifies $-CH_2CH_2-$, $-CH(CH_3)CH_2-$, or $-CH_2CH(CH_3)-$, provided further that one of the A^{22} can be hydrogen;

D is methyl, ethyl, propyl, $-(CH_2)_{1-3}COO^-$, benzyl or hydrogen;

i is 0 or 1 and j is 0 or 1, provided that the sum of (i + j) is 1 or 2;

each X^{22} is a straight or branched saturated or unsaturated aliphatic group containing up to 3 carbon-carbon double bonds and containing 11 to 23 carbon atoms;

n is (two minus the number of $-(CH_2)_{1-3}COO^-$ substituents present); and

Z^{22} is an anion;

(xxiii) compounds of the formula

$$R^{23}-[C(O)O(CH_2)_{1-5}]_{0-1}-C(O)NH(CH_2)_{2-5}-N(R^{23a})(R^{23b})-(CH_2)_{2-5}-OC(O)R^{23}X^-$$

wherein

each R^{23} is independently straight or branched alkyl or alkenyl containing 8 to 22 carbon atoms;

R^{23a} is straight or branched alkyl or hydroxyalkyl containing 1 to 3 carbon atoms, benzyl, or $-C_2H_4OC(O)R_4$ wherein R^4 is straight or branched alkyl or alkenyl containing 8 to 22 carbon atoms;

R^{23b} is H, $-CH_3$, $-C_2H_5$ or benzyl; and

X^- is an anion.

(In the foregoing, "Adogen", "Arosurf" and "Varisoft" are trademarks of Witco Corp.)

The compositions of the present invention also contain water but are diluted into or by water in each application area.

The amounts of the cationic, anionic, amphoteric or nonionic component, the one or more

components corresponding to formula (1), and water, can vary within relatively large ranges, depending upon the degree of concentration of the components desired, and depending also on the particular characteristics of the particular components selected. The cationic component should be present in an amount at least sufficient to afford the desired effect (i.e. fabric or textile softening, paper debonding, hair conditioning, and so forth, as the case may be) and can be present in amounts substantially higher representing commercial concentrations on the order of 5-25 wt.% up to amounts on the order of 30 percent or higher, up to 60, 70, 80 or even 90 wt.% of the composition. These higher contents represent concentrates from which useful compositions can be formulated upon dilution or used as is, if desired due to their dispersibility in water.

Compositions in accordance with the present invention exhibit superior stability, by which is meant that they do not separate into more than one phase even upon standing, without agitation, for prolonged periods of time on the order of a year or longer. They generally form more fluid formulations, require lower levels of the diol or diol alkoxylate than of other coupling agents to function, and are nonflammable with high exposure limits. They also give very easy-to-disperse formulations even when the formulations are highly concentrated, and thus function better in each application. They generally give added fluidity to even difficult to handle surfactants and enable those same surfactants to be

dispersed in much colder water than is the case with other coupling agents.

The compositions of the present invention are particularly useful in applications that take advantage of their ability to disperse hydrophobic material, to stabilize foam, and to enhance the penetration and wetting exhibited by the compositions. Examples of such applications include:

Oil dispersants and oil slick dispersants, wherein one applies onto oil (for instance, onto a film of oil) a sufficient amount of a composition according to the present invention, containing a sufficient concentration of surfactant, such that the composition disperses the oil.

Oil well stimulation and oil recovery aids, wherein one injects into an oil well a composition according to the present invention in order to penetrate into the surface of the borehole and assist liberation of crude oil from the matrix material into the hole, from which it can be brought to the surface.

Vehicles for hydrophobic sheeting agents such as mineral oil and silicone oil. Such oils can readily be dispersed in compositions, according to the present invention, and the resulting formulations are highly satisfactory when sprayed or otherwise applied to a surface (such as freshly washed automobile surfaces) to impart a lustrous, water-repellent film to the surface.

Formulation of fabric and textile softeners, wherein components capable of imparting fabric softening (typically, quaternary ammonium compounds

such as di-(C_{12-22}-alkyl)-di(C_1-C_4 alkyl) ammonium chloride or methylsulfate, or 1,3-disubstituted imidazolinium salts) are incorporated into the composition thereby forming a fluid, monophasic, typically clear composition.

Paper deinking and ink flotation, wherein waste inked paper is pulped as a slurry in an aqueous liquid comprising a composition according to the present invention so that ink is liberated from the paper, and prevented from redepositing onto the paper; typically the ink is dispersed or even fully solubilized in the liquid composition of this invention or when the ink particles are floated from the fibers.

Paper debonding, wherein paper fibers are pulped in the headbox of a papermaking machine as a slurry in an aqueous liquid comprising a composition according to the present invention, just prior to feeding the slurry onto the dewatering screen, to improve the softness of the paper product formed.

Asphalt emulsions, wherein finely divided asphalt is emulsified (at loadings typically 1-20 wt.%), with or without particulate filler such as sand, in an aqueous phase which comprises the composition according to the present invention.

Hair and skin conditioning formulations, wherein effective amounts (e.g. 0.1 wt.% to 10 wt.% or more) of emollients, humectants, and/or slip and conditioning agents (e.g. organopolysiloxanes and the like) are incorporated with the composition of the present invention to create formulations that are

monophasic and can be made to be translucent or even clear. Compounds suitable for use as emollients, humectants and conditioners in formulations for skin care or hair care can be found in the CTFA Cosmetic Ingredient Dictionary, 3d Edition, and in the CTFA Cosmetic Ingredient Handbook.

Corrosion inhibitors, wherein an effective amount of a hydrophobic corrosion inhibiting material (such as liquid or waxy-solid fatty ester, paraffinic hydrocarbon or silicone) is dispersed in a composition according to the present invention. The resulting formulation is applied to any surface to which one desires to apply a film that protects against corrosion.

Ore flotation, wherein a relatively hydrophobic material used as e.g. a collector or frother --depending on the characteristics of the particular separation desired in the flotation cell-- is dispersed in a composition according to this invention. An amount effective to carry out the intended function is then fed (on a batch or continuous basis) to the cell. The composition of the present invention permits the formulator to improve the dispersibility of the collector(s) which are often very hydrophobic. This can often improve performance of the mineral separation by improving the efficiency of the chemical's dispersiblity. This can enable the operator to use smaller amounts (at the higher concentration of active now available) of the formulation to achieve the desired purpose.

Rinse aids, such as used in automatic dishwashers, wherein application of the composition of the present invention disperses residual hydrophobic matter, including cleaner residues and films.

Suspension concentrates and emulsifiable concentrates of herbicides, pesticides, miticides, fungicides, and/or bactericides, wherein one or more liquid or solid, generally hydrophobic, active ingredients are dispersed in a composition according to the present invention. The concentrate can be applied as is on or around desired vegetation; but is more often mixed (e.g. at the point of use) with water of dilution to form a final formulation having the desired concentration of active ingredient(s). This application takes advantage of the noteworthy property of this invention that addition of the water for dilution does not disrupt the monophasic state, nor the fluidity, of the formulation.

Generally speaking, the amount of coupling agent can range from about 0.1 wt.% or 10 wt.% to about 50 wt.%, with the particular amount readily identified by the formulator. Water may not necessarily be present, but usually is present in amounts that can be up to about 90-95 wt.%.

The one or more surfactants (which may exhibit low solubility in water) will generally be present in amounts on the order of 0.1 wt.% to about 90 wt.%, and similarly the particular amount can readily be ascertained by the formulator. The invention is particularly utilizable in embodiments wherein the amount of surfactant(s), in the

aggregrate, exceeds 10 wt.%, i.e. 15 wt.% or more. Indeed, it has quite surprisingly been determined that compositions in accordance with the present invention can be prepared wherein the amount of surfactant(s) is at least 20-25 wt.%, or even 30 wt.% or higher, ranging up to 50 wt.% or higher, yet the composition remains monophasic and retains its fluidity and its ability to be compounded with other components without suffering phase separation, turbidity or excessive viscosity.

The compositions of the present invention can also optionally contain other components, depending on the additional properties one may wish to provide in the finished composition. Such additional components include, but are not limited to, additional coupling agents and solvents, thickeners, fragrances, coloring agents, hydrocarbon actives, and so forth.

The compositions of the present invention have particular usefulness in applications not calling for the presence of inorganic or organic salts. It is customary to incorporate quantities of such salts, known often as "builder" salts or "detergency builder" salts, particularly when cleaning functionality like hard surface cleaning is desired. However, the present invention is applicable to a considerable number of utilities that do not need the presence of builder salts, since they are not related to cleaning hard surfaces. The ability of the present invention to be so versatile and functional in applications without builder salts is one of the many unexpected and noteworthy aspects of the present invention.

FABRIC SOFTENERS

The component of formula (1) is present in an amount sufficient to form with the cationic component a phase-stable, water-dispersible formulation. In general, satisfactory amounts of the one or more compounds of formula (1) correspond to a weight ratio with respect to the amount of cationic component present of 1:30 to 5:1 (diol or diol alkoxylates:fabric softener), and preferably 1:10 to 1:1.

The fabric softening compositions of the present invention can also contain conventional additives known to those familiar with this field, including colorants, fragrances, preservatives, and the like. In addition, if desired a small but effective amount up to about 2 wt.% of one or more inorganic salts, such as sodium chloride or calcium chloride, can be added to adjust the viscosity of the composition. Other components that can be present, and often are present, include monoalkyl nonionic materials such as fatty alcohols, fatty acid ethoxylates and propoxylates, monoalkyl esters or poly(ethylene glycol) esters of fatty acids, polysiloxanes, and amine-funcional polysiloxanes; other cationic surfactants; solvents such as short chain alcohols with up to about 6 carbon atoms (e.g. ethanol, isopropanol); lower glycols and glycol ethers, containing up to about 12 carbon atoms, such as ethylene glycol, diethylene glycol, propylene glycol, propylene glycol ether, propylene glycol butyl

ether, and the like; polyethylene glycols; polypropylene glycols; fatty ethers; and hydrocarbons.

Compositions having the foregoing characteristics can readily be prepared by simply stirring together in appropriate equipment the diol and/or diol alkoxylate component, with the one or more compounds constituting the cationic component, into the water, along with any other desired additives.

The cationic compositions of the present invention afford a number of advantages not heretofore contemplated. One advantage is ease of formulation of these cationic compositions. Conventionally, emulsion-based cationic formulations can be made to a concentration of up to about 25 wt.% solids, employing high shear and requiring the addition of a salt such as calcium chloride for viscosity control. Solvent based (clear or transparent) cationic formulations can be made conventionally containing about 40 to about 60 wt.% solids, but often go through a gel-like phase which is very difficult to disperse, such that an acceptably uniform dispersion of the cationic component can be impossible to achieve. They normally require large levels (e.g. 10% or more) of flammable solvent such as isopropanol or ethanol, and/or hexylene glycol or propylene glycol, to formulate.

On the other hand, compositions prepared in accordance with the present invention exhibit a noticeable ease of dispersibility in water at any concentration level and can be thinned by adding $CaCl_2$ to form clear, fluid formulations. This is quite unique compared to those compositions outside the

scope of the present invention requiring additions of e.g. isopropanol and/or ethanol and/or hexylene glycol, which revert back to the emulsion when salts are added. Much higher levels of alcohol and short-chained glycols are needed to maintain fluidity in such compositions. As much as 2 to 5 times more of such conventional solvents or coupling agents are needed for acceptable fluidity than is the case using the C_7-C_{12} diols and diol alkoxylates in accordance with the present invention. In addition, the compositions of the present invention do not readily gel when added to water for purposes of dilution. Thus, products of a concentration useful in the home can be prepared from concentrates very easily by simply dispersing an appropriate amount of the concentrate into room temperature water.

Another advantage is the appearance of the product. An opaque fabric softener or other cationic product is less desirable both because the appearance is considered to be unattractive to the consumer and also because it indicates that the distribution of the fabric softening components in the composition is not homogeneous. In the case of fabric softeners, this possibly results in uneven deposition of the fabric softener component on the clothing and possibly even results in staining of the fabric by the fabric softener component. On the other hand, fabric softener and other cationic compositions in accordance with the present invention can be made to appear clear or translucent, and upon addition of high amounts of water quickly form a correspondingly milky

or clear, uniform product appearance. The iodine value (I.V.) of the cationic quaternaries to obtain clear formulations must be at least about 50 and is more preferably 60-90. Quaternaries derived from oleyl or soft tallow fatty acids especially can be made to give clear formulations.

The ease of formulation and dispersibility has other beneficial effects, including reduction in heating costs for formulators (who conventionally must heat the blend of components to help achieve the desired uniformity of distribution), and reduction in the amount of energy expended in mixing and transport. These features make it feasible to sell highly concentrated cationic formulations directly to the user, who prepares products having the concentrations conventionally employed from the concentrate by diluting an appropriate small quantity of concentrate with tap water or by adding it directly (for instance, by adding a small amount of a fabric softener concentrate) into the automatic dispenser on the machine where it is diluted and added to the rinse cycle.

Thus, both the emulsion type, clear and even clear gels can be made using the techniques disclosed herein. The diol of formula (1) allows the cationic agent to be dispersed into water or to be diluted with water to any of a wide variety of concentrations and physical states (e.g. gels, clear products, and emulsions).

The following examples, which are intended for purposes of illustration and not intended to limit

the scope of the protection sought for the invention described herein:

EXAMPLE 1

Preparation of Diol Alkoxylate

To a 2-liter Parr reactor was charged 438 grams (3.0 moles) of 2,2,4-trimethyl-1,3-pentane diol and 0.54 grams (0.1 wt.%) of potassium hydroxide. The reactor was sparged with nitrogen and evacuated three times. After heating the contents to 100°C under vacuum, the reactor was pressured to 10 psia with nitrogen, and heated to 150°C.

Ethylene oxide (264 grams, 6.0 moles) was added over one hour at 150°-160°C and 50-60 psi. After an additional one hour reaction time, the contents were cooled to 100°C and a vacuum was pulled to remove any residual ethylene oxide. The product was a clear liquid which had a hydroxyl value of 428 determined by acetylation on a hotplate and titration using KOH (Reference: ASTM Test E222, Method B).

EXAMPLE 2

The following are examples of fabric softener formulations prepared in accordance with the present invention.

FORMULATION A	
Component	% by Weight
Disofttallowdimethyl ammonium chloride 75 wt.% in isopropanol("Adogen 470", Witco Corp.)	50.0
Diol alkoxylate formed by alkoxylating 2,2,4-trimethyl-1,3-pentane diol with one mole of ethylene oxide	12.5
Deionized water	37.5
Total	100.0

Procedure: The diol alkoxylate was blended with the quaternary ammonium compound, and then water was added, with light stirring until the mixture was homogeneous. All ingredients were added and combined at 20°C. The resulting product was a high solid content, clear, homogeneous liquid formulation.

FORMULATION B	
Component	% by Weight
Dihardtallowdimethylammoniumchloride, 75% solution in isopropanol ("Adogen 442", Witco Corp.)	3.4
2,2,4-trimethyl-1,3-pentanediol	1.1
Deionized water	95.5
Total	100.0

The quaternary ammonium compound was blended with the C_8 diol and this blend was added to the water at 90°F with light agitation until the materials were completely dispersed. The resulting product was a cloudy, emulsion-type yet almost clear, liquid composition with a viscous appearance. This example demonstrates yet a further advantage of the present invention, namely that employing the diol alkoxylates as described herein permits the preparation of a cationic composition having a given viscosity with the use of a smaller amount of cationic component than would be necessary to achieve that given viscosity level using the same cationic component without using the diol.

The viscosity of Formulation B was about 175 cps, whereas the viscosity of the "Adogen 442" alone, at the same level of quaternary in water, is about 15 cps.

FORMULATION C	
Component	% by Weight
Dimethylbis(softtallowamidoethyl)-2-hydroxyethylammoniummethylsulfate ("Varisoft 222 LM-90", Witco Corp.)	80.0
Diol alkoxylate produced by ethoxylating 2,2,4-trimethyl-1,3 propane diol with 2-moles of ethylene oxide	20.0

This product is a non-aqueous concentrate which is readily dispersible in water at a temperature down to 45°F. Such dispersion produces readily a homogeneous, liquid cationic composition which is uniform in appearance. This product can be diluted, or used as is, in industrial and institutional applications as well as in household applications as a fabric softener or textile finishing agent.

FORMULATION D	
Component	% by Weight
Methyl-1-oleylamidoethyl-2-oleylimidazoliniummethylsulfate ("Varisoft 3690", Witco Corp.) 90% in isopropanol	75.0
Diol alkoxylate produced by ethoxylating 2,2,4-trimethyl-1,3-propanediol with 2 moles of ethylene oxide	25.0

The indicated components were blended together at room temperature, which readily produced a

cationic formulation, useful as a fabric softener, paper debonder or textile finishing agent, having a relatively high concentration of active ingredient and which exhibited a homogeneous, uniform appearance. This product could easily give a very clear final formation, and can be diluted easily to below 10% solids for a clear, thick, low solids softener, or can be used with 3-6% additional isopropanol or ethanol as solvent to form a 40-50% clear, ultra concentrate for the household market.

Among the advantages of the present invention is the high degree of dispersibility in water, even cold or room temperature water, and the resultant ability to formulate from a more highly concentrated form to any target concentration level in water (even room temperature) regardless of temperature with only minimal agitation. Other advantages include odor and low cost effectiveness compared to conventional coupling agents. The lack of formation of a gel phase during dilution or dispersion of the material in water is believed to be due to the material forming very fine particles when added to cold water; this feature also improves fabric softener performance in the washing machine, and provides freedom from having to add salts for adjustment of viscosity. Salts such as $CaCl_2$ may be added to reduce viscosity in those formulations where lower solids "clear" formulations are being produced. Additional advantages include the clarity of the final composition and freedom from having to include excess volatile organic components in the product.

Cationic emulsions are normally unstable, especially when subjected to freezing and thawing, and have shelf lives of only 3-5 months. On the other hand, emulsions utilizing diol or diol alkoxylate of formula (1) exhibit much longer-term stabilities and better stability against freeze-thaw cycles. They also show good viscosity stability as well in dispersions up to about 10-15 wt.% in most cationic quaternary systems.

Additional Practical Exemplification

Laboratory work with compositions according to the present invention has demonstrated numerous specific advantageous aspects including, but not limited to, those set forth as follows.

The diols of formula (1), particularly TMPD, reduce the melting point of the quaternary component; this feature greatly assists dispersibiliity of the cationic agent in water. Thus, for any given water temperature, the quaternary component can be dispersed more readily --and in a larger amount, if desired-- when one or more components of formula (1) is present. The presence of the diol or diol alkoxylates also enables water to be added to the quaternaries and cationics, as well as the customary mode of adding the material to the water. This is unprecedented, as normally most quaternaries will gel if water is added to them as the quaternary solids content go to below 40%.

The diols and diol alkoxylates increase the viscosity of some formulations of quaternary compounds, easily by 10-fold or more. For a given

content of quaternary compound(s), there is generally a range of the diol/diol alkoxylate component within which optimum high viscosity is exhibited; higher amounts of diol/diol alkoxylate with respect to the amount of quaternary present can reduce the viscosity compared to that obtained at lower diol and diol alkoxylate levels, and thereby form easily dispersed formulations.

Softening Performance

It has been determined that cationic formulations containing diol and/or diol alkoxylate of formula (1) provide fabric softening performance which is superior to that provided by comparable formulations without the diol/diol alkoxylate. Superior performance has been exhibited when the formulation used a C_7-C_{12} diol. Typical results are in the following table:

Comparison of Softening Performance
with TMPD vs. Emulsions w/o TMPD

(All tests used quaternary as 0.1 wt.% of fabric weight.)

Softener	Wt.% of active in deionized water	Ratio (wt.%) of Quat.: TMPD	Softening Rank (5=Best)
Di (hydrogenated tallow)-dimethyl ammonium chloride (as 75% formulation in isopropanol) (Adogen "442")	3%	--	3.1
	3%	4:1	3.8
	3%	3:2	4.1
			(3=Best)
Methyl-1-tallow amidoethyl-2-tallow-imidazolinium-methyl sulfate ("Varisoft 475-90")	23.3%	--	1.3
	26.8%	3:2	1.7

In these experiments, all quaternary concentrations were held exactly equivalent; and the experiments were performed using identical testing conditions. Thus, any performance improvement is attributed to the presence of the TMPD.

These data confirm that the presence of the diol contributes additional fabric softening capability to the formulated product.

Clear Formulations

Formulations in accordance with this invention which exhibit acceptable clarity can be obtained with appropriate balance of the amounts of the softener and diol/diol alkoxylate components, the amounts of other components such as electrolytes, and the conditions (especially temperature) under which the formulations are prepared. In general, at lower softener contents, a higher ratio of TMPD or other diol and/or diol alkoxylate to the system needs to be observed.

Additional examples of formulations according to this invention are:

NONFLAMMABLE IMIDAZOLINIUM QUATERNARY FORMULATION
(useful as e.g. fabric softener, textile finishing, paper debonder)

A. Concentrate

80% Methyl-1-tallow amidoethyl-2-tallow imidazolinium methyl sulfate ("Varisoft 475")(as 90% conc. in isopropanol)
15% TMPD
5% H_2O

This product exhibits the following beneficial properties:

- Dispersible in room temperature water
- Non-flammable
- Easy to handle
- No need to heat or store the product at elevated temperatures

- Stable dispersions at from 1-12% solids
- Superior softening and antistatic properties vs. softener without the diol
- Good rewetability
- Thick viscosity at about 5-8% solids

Typical Properties

Appearance	light yellow liquid
Total Solids(%)	72%
Density (gm/cc)	.92
Flash Point (PMCC) °F	>200°F

B. Formulations for Use

Wt.% of solids:	3%	5.5%	8%
Approx. Viscosity (cps.)	20	75	600
% Quat:	4.3%	7.85%	11.4%
% Tap Water	95.7%	92.15%	88.6%

Procedure for concentrate dilution:

Measure water required for dispersion into a suitable mixing vessel. Water temperature should be above 70°F. Add room temperature quaternary to the water with mild agitation. Continue agitation for 15 to 30 minutes until the softener is completely dispersed. Add dye, fragrance and preservative as required or needed. Solids of greater than 7% may need to be thinned using a $CaCl_2$ brine. Small amounts (less than .5% $CaCl_2$) should be used.

HIGH VISCOSITY/LOW-SOLIDS QUATERNARY FORMULATION

A. Concentrate

42.5% Methyl bis (tallow amidoethyl) 2-hydroxyethyl ammonium methyl sulfate ("Varisoft 222 LM-90") (as 90% conc. in isopropanol)

42.5% "Adogen 442" (as 75% conc. in isopropanol)

15% TMPD

This product exhibits the following beneficial properties:

- Good softening and antistatic control
- Easy to handle (fluid at 60°F.)
- Dispersible at water temperature as low as 65°F
- High viscosity at less than 4% solids
- Good formulation stability down to 1%
- Can achieve elevated viscosity when Quat is dispersed at water temperatures below 75°F.

Typical Properties

Appearance	light yellow liquid
Pour Point (°F)	50°
Flash Point (PMCC) °F	86°
% IPA	10°
Total solids (%)	70%
Solids Formulation Range (%)	.5 to 8%

B. Typical End-Use Formulations

Solids Content	2.5% Solids		4% Solids	
Dispersion Water Temp. (°F)	>75°F	<75°F	>75°F	<75°F
Viscosity of Formulation, cps	15	150	180	400

Formulation:		
% Product	3.6%	5.7%
% Water	96.4%	94.3%

Procedure:

Measure water at desired temperature (to achieve desired viscosity) into a vessel equipped with a mixing agitator. Add room temperature quaternary (70-80°F) slowly to water under agitation. Mixing smoothly without whipping air into the dispersion reduces foam problems and having air contained in the thicker dispersion. Agitate until completely dispersed- usually 15-30 minutes depending on the type of agitation. Add dye, fragrances, preservatives as desired. If foam develops during mixing or bottling, add a few ounces of defoamer such as Antifoam B (Dow Corning).

"CLEAR" (ADJUSTABLE VISCOSITY) SOFTENER FORMULATION

A. Concentrate

80% Ditallow dimethyl ammonium chloride ("Adogen 470") (as 75% conc. in isopropanol)

20% TMPD

This product exhibits the following beneficial properties:

- Excellent softening with good antistatic control
- Clear formulation
- Variable solids content from 10 to 40% or greater

- Easy to handle
- Can be used as a "dilutable" to form a thick emulsion-type product when added to water down to 3-6% solids
- Versatle viscosity from thin to thick using e.g. $CaCl_2$ as thinning agent
- Can be used to form cold-water-dispersible formulations of 4-6% solids (viscosity of 70-200cps)
- Great dispersibility in cold water

Typical Properties

Appearance	Clear yellow fluid
liquid	
Total solids (%)	58%
Density (gm/cc)	0.87
Flash point (PMCC)	70°F
Min. Handling Temp. (°F)	40
Cloud Point (°F)	45

B. Typical End-Use Formulations

	18-20%	24-26% solids	30-35% solids
Concentrate	33%	42%	52%
$CaCl_2$	.05-.15%	.2-.4%	.02-.125%
Water	Balance to 100%		
Dye, Preservative and Fragrance	As desired or recommended by suppliers		

Procedure:

Charge water into a suitable mixing vessel. Add proper level of $CaCl_2$ to obtain stable, clear final softener formulation. Add all required Quat to water and begin to agitate. Upon mild agitation a "clear" fluid (or viscous if desired) softener formulation will form. Initially during blending, periods of hazy or even opaque dispersion may exist prior to "clearing." Too much $CaCl_2$ should be avoided as it will lead to splitting out of the softener. Too little $CaCl_2$ will result in high viscosity or even a gel. If too much $CaCl_2$ is added, water can be added diluting the formulation and switching the formulation back to a clear formulation.

HAIR CARE CONDITIONER (9 wt.% solids)

Ingredient		Amount (wt.%)
I:	Deionized water	90.0
	Quaternium 10 (polymeric quaternary ammonium salt of hydroxyethyl cellulose reacted with trimethyl ammonium-substituted epoxide)	0.5
	Hydroxyethylcellulose	0.5
	Glycerine	1.6
II:	"Adogen 442" (as 75% conc. in isopropanol)	3.5
	TMPD x 1-mole ethoxylate	1.4
	Oleth-2 (oleyl alcohol x 2-mole ethoxylate)	1.5
	Hydrogenated coconut oil	1.0
III.	Preservative	q.s.

Mixing instructions: Mix I, until uniform, then heat to 70°C. Mix II. to uniformity and heat to 70°C. Add II. to I. with agitation. Add III. Cool, with mixing, to 30°C.

PAPER DEBONDERS

Ingredient	Amount (wt.%) A	Amount (wt.%) B
Di(hard tallow) dimethyl ammonium methyl sulfate	50	
Methyl-1-oleyl amidoethyl-2-oleyl imidazolinium methylsulfate		80
TMPD	20	10
TMPD x 2-mole ethoxylate	20	
TMPD x 1-mole ethoxylate		10
Water	5 (melts at 75-80°F; dispersible in 85°F water)	

NON-FLAMMABLE TEXTILE FINISHING FORMULATION

Ingredient	Amount (wt.%)
Methyl bis (tallowamidoethyl) -2-hydroxyethyl ammonium methylsulfate (as 85% conc. in hexylene glycol)	81
TMPD	14

Water

Approximate pour point = 55°F.
Approximate minimum water dispersal temperature = 50°F.

The following are additional examples of more particular formulations embodying the compositions of the present invention. These examples are provided for purposed of illustration, and should not be deemed to limit the scope of the invention.

EXAMPLES

Carwash Sheeting Spray

Component (wt.%)	Typical Amount wt.%	Exemplary Amount
Dicoco dimethyl ammonium chloride (78% in isopropanol)	10-30	20
Diol or diol alkoxylate (e.g. TMPD or TMPD-monoethoxylate)	2-10	5
Mineral seal oil	20-30	25
Water	40-60	50

Clear Fabric Softener

Component (wt.%)	Typical Amount (wt.%)	Exemplary Amount
Di(soft tallow) dimethyl ammonium chloride	30-40	35
TMPD	5-12	10
$CaCl_2$	0.1-0.4	0.2
Fragrance/dye preservative	trace	trace
Water	50-60	55

Paper Debonder Concentrate

Component (wt.%)	Typical Amount (wt.%)	Exemplary Amount
Di(hard tallow) dimethyl ammonium methylsulfate	40-50	45
TMPD	20-30	25
TMPD x 3-mole ethoxylate	20-30	25
Water	2.5-10	5

Textile Softener Concentrate
(cold water dispersible, nonflammable)

Component (wt.%)	Typical Amount (wt.%)	Exemplary Amount
Methyl-1-tallow amidoethyl-2-tallow imidazolinium methylsulfate	50-75	70
TMPD	10-15	14
TMPD x 3-mole ethoxyate	10-15	12
Water	2-10	4

Oil Field Foam Booster

Component (wt.%)	Typical Amount (wt.%)	Exemplary Amount
Blend of anionic and nonionic surfactants	30-50	40
Alpha-olefin sulfonate	30-50	40
2-ethylhexane-1, 3-diol-monoethoxylate	10-30	20

Oil Slick Dispersant

Component (wt.%)	Typical Amount (wt.%)	Exemplary Amount
Nonyl phenol ethoxylate	10-30	20
Dioctyl sulfosuccinate	10-20	15
TMPD x 2-mole ethoxylate	5-15	10
Water	50-60	55

Low Foaming Automatic Dishwasher Rinse Aid

Component (wt.%)	Typical Amount (wt.%)	Exemplary Amount
Poly(ethoxy)-poly(propoxy)block copolymer	15-35	25
TMPD X 7-mole ethoxylate	15-30	25
Water	35-70	50

WHAT IS CLAIMED IS:

1. A homogeneous liquid composition comprising:

(a) one or more compounds of the formula (1)

$$HO(X\text{-}O)_x\text{-}R\text{-}(O\text{-}Y)_y\text{-}OH \qquad (1)$$

wherein each X is ethylene, straight or branched propylene, or straight or branched butylene;

x is 0 to 40;

each Y is ethylene, straight or branched propylene, or straight or branched butylene;

y is 0 to 40;

the sum of (x+y) is 0 to 40; and

R is saturated, straight, branched or cyclic alkylene containing 4 to 12 carbon atoms, provided that if x and y are both zero then R contains 7 to 12 carbon atoms; and

(b) one or more cationic, anionic, amphoteric or nonionic agents.

2. A composition in accordance with Claim 1 containing at least one compound according to formula (1) wherein x and y are both zero.

3. A composition in accordance with Claim 1 containing at least one compound according to formula (1) wherein x and y are both zero and R is branched noncyclic alkylene containing 7 to 8 carbon atoms.

4. A composition in accordance with Claim 1 containing one or both of 2, 2, 4-trimethyl-1, 3-pentane diol and 2-ethylhexane-1, 3-diol.

5. A composition in accordance with Claim 1 containing 2, 2, 4-trimethyl-1, 3-pentane diol.

6. A composition according to Claim 1 containing at least one compound of formula (1) wherein one or both of x and y is greater than zero.

7. A composition in accordance with Claim 6 containing at least one compound of formula (1) wherein each X, if x is greater than zero, and each Y, if y is greater than zero, is ethylene.

8. A composition in accordance with Claim 6 containing at least one compound of formula (1) wherein the sum of (x + y) is 1-10.

9. A composition in accordance with Claim 8 containing at least one compound of formula (1) wherein each X, if x is greater than zero, and each Y, if y is greater than zero, is ethylene.

10. A composition in accordance with Claim 1 containing at least one compound of formula (1) wherein the sum of (x + y) is 2-5.

11. A composition in accordance with Claim 6 containing at least one compound of formula (1) wherein R is the residue of 2, 2, 4-trimethyl-1, 3-pentane diol or of 2-ethylhexyl-1, 3-diol.

12. A composition in accordance with Claim 6 containing at least one compound of formula (1) wherein R is the residue of 2, 2, 4-trimethyl-1, 3-pentane diol.

13. A composition in accordance with Claim 12 containing at least one compound of formula (1) wherein R is the residue of 2, 2, 4-trimethyl-1, 3-pentane diol and each X and Y present is ethylene.

14. A composition in accordance with Claim 13 containing at least one compound of formula (1) wherein R is the residue of 2, 2, 4-trimethyl pentane-1, 3-diol, and the sum of (x + y) is 1-10.

15. A composition in accordance with Claim 12 containing at least one compound of formula (1) wherein R is the residue of 2, 2, 4-trimethyl pentane-1, 3-diol, and the sum of (x + y) is 1-10.

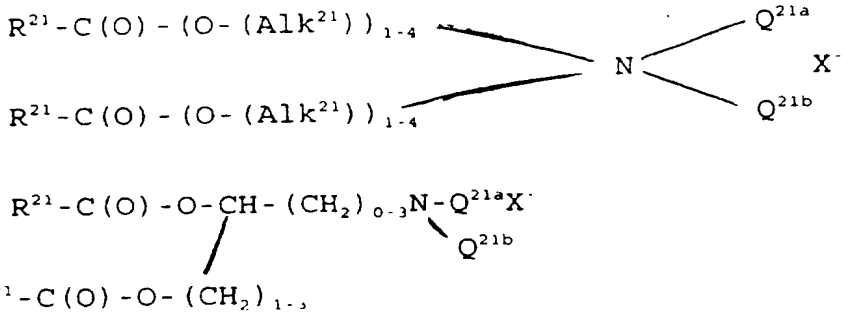
16. A composition in accordance with Claim 1 which contains di(hydrogenated tallow) dimethyl ammonium chloride.

17. A composition in accordance with Claim 1 which contains methyl bis(tallowamidoethyl-)-2-hydroxyethyl ammonium methylsulfate.

18. A composition in accordance with Claim 1 which contains methyl-1-tallowamidoethyl-2-tallow-imidazolinium methylsulfate.

19. A composition in accordance with Claim 1 which contains one or more compounds selected from the group consisting of

compounds of any of the formulas



$R^{23}-[C(O)O(CH_2)_{1-5}]_{0-1}-C(O)NH(CH_2)_{2-5}-N(R^{23a})(R^{23b})-(CH_2)_{2-5}-OC(O)R^{23}X^-$

wherein each R^{21} is independently a saturated or unsaturated alkyl or alkylene radical containing 12 to 22 carbon atoms;

Q^{21a} and Q^{21b} are alkyl containing 1 to 4 carbon atoms or benzyl, $-CH_2CH_2OH$, or $-CH_2CH(OH)CH_3$, or Q^{21a} can be $R^{21}-C(O)-(O-(Alk^{21}))_{1-4}-$;

each Alk^{21} is independently C_2H_4, C_3H_6 or C_4H_8;

R^2 is alkyl containing 1 to 4 carbon atoms or benzyl, $-CH_2CH_2OH$ or $-CH_2CH(OH)CH_3$;

each R^{23} is independently straight or branched alkyl or alkenyl containing 8 to 22 carbon atoms;

R^{23a} is straight or branched alkyl or hydroxyalkyl containing 1 to 3 carbon atoms, benzyl, or $-C_2H_4OC(O)R_4$ wherein R^4 is straight or branched alkyl or alkenyl containing 8 to 22 carbon atoms;

R^{23b} is H, $-CH_3$, $-C_2H_5$ or benzyl; and

X^- is an anion.

20. A stable monophasic liquid composition characterized by the ability to solubilize increased amounts of surfactant into said composition while retaining a monophasic state, which composition is useful as a dispersant of hydrophobic material and consists essentially of water; one or more surfactants selected from the group consisting of cationic surfactants, anionic surfactants, amphoteric surfactants, nonionic surfactants, and mixtures thereof; and

one or more coupling agents selected from the group consisting of straight, branched and cyclic alkanes containing 7 to 12 carbon atoms and substituted with two hydroxyl groups, and alkoxylates thereof containing up to 20 alkoxy units each of which is ethoxy, propoxy or butoxy, and mixtures thereof, in an amount of said one or more coupling agents effective to increase the amount of said one or more surfactants that can be solubilized in said monophasic composition.

21. A composition in accordance with Claim 20 comprising one or more coupling agents selected from the group consisting of straight, branched and cyclic alkanes containing 7 to 12 carbon atoms and substituted with 2 hydroxyl groups, and mixtures thereof.

22. A composition in accordance with claim 20 comprising one or more coupling agents selected from the group consisting of 2, 2, 4-trimethylpentane-1, 3-diol and 2-ethylhexyl-1, 3-diol and mixtures thereof.

23. A composition in accordance with claim 20 wherein said one or more surfactants comprise more than 10 wt.% of said composition.

24. A composition in accordance with claim 20 wherein said one or more surfactants comprise at least 20 wt.% of said composition.

25. A composition in accordance with claim 20 comprising 0.1 wt.% to 50 wt.% of one or more coupling agents selected from the group consisting of straight, branched and cyclic alkanes containing 7 to

12 carbon atoms and substituted with 2 hydroxyl groups and mixtures thereof.

26. A composition in accordance with claim 20 comprising one or more coupling agents selected from the group consisting of alkoxylates of straight, branched and cyclic alkane diols containing 7 to 12 carbon atoms, said alkoxylates containing up to 20 alkoxy units each of which is ethoxy, propoxy or butoxy, and mixtures thereof.

27. A composition in accordance with claim 26 wherein each of said alkoxy units is ethoxy.

28. A composition in accordance with claim 26 comprising one or more coupling agents selected from the group consisting of alkoxylates of 2, 2, 4-trimethyl pentane-1, 3-diol and 2-ethylhexyl-1, 3-diol and mixtures thereof, said alkoxylates containing up to 20 alkoxy units each of which is ethoxy, propoxy or butoxy, and mixtures thereof.

29. A composition in accordance with claim 28 wherein each of said alkoxy units is ethoxy.

30. A composition in accordance with claim 26 comprising 0.1 wt.% to 50 wt.% of said one or more coupling agents.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/06107

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :Please See Extra Sheet.
US CL :252/8.6, 8.8., 8.9, 312, 351, 542, 547
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 252/8.6, 8.8., 8.9, 312, 351, 542, 547, DIG.1, DIG.6, DIG.13, DIG.14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, 4,692,277 A (SIKLOSI) 08 September 1987 (08.09.87), examples II and VII; and column 3, line 54-column 4, line 31.	1-5, 20-25
X	US, 5,202,050 A (CULSHAW ET AL.) 13 April 1993 (13.04.93), examples I, IV, VII, VIII and X.	1-5, 20-25
X --- Y	US, 4,338,212 A (WEGENER ET AL.) 06 July 1982 (06.07.82), example 4; abstract.	1,2, 6-10, 20 23, 24, 26-30 --- 15-18
Y	EP 0,317,542 B1 (THE PROCTER & GAMBLE COMPANY) 24 May 1989 (24.05.89), page 4, lines 6-14; and page 3, lines 35-38.	15

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 15 JULY 1996	Date of mailing of the international search report 29 JUL 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer RICHARD D. LOVERING TCJ Telephone No. (703) 308-1235

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/06107

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0,619,363 A1 (COLGATE-PALMOLIVE COMPANY) 12 October 1994 (12.10.84), page 4, lines 3-52; and page 3, line 1.	15-18
A	US 3,779,934 A (ALTENSCHOPFER ET AL.) 18 December 1973 (18.12.73), see entire document.	1-30
A	US, 3,915,867 A (KANG ET AL.) 28 October 1975 (28.10.75), see entire document.	1-30
A	US, 4,769,159 A (COPELAND) 06 September 1988 (06.09.88), see entire document.	1-30

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/06107

A. CLASSIFICATION OF SUBJECT MATTER:
IPC (6):

B01F 17/42; B01J 13/00; C11D 1/18, 1/52, 1/58, 1/72; D06M 13/148, 13/352, 13/402, 13/46